- Up to ≤40% Binder Replacement from RAP or RAP + RAS
- RAS Replacement must be ≤25% of the 40%

INDIANA DEPARTMENT OF TRANSPORTATION

Driving Indiana's Economic Growth

- No PG Δ if ≤ 25% Replacement

Memorandum

- Drop High + Low PG 1 Grade for Binder Replacement of ≥25 + ≤40%

March 23, 2010

CONSTRUCTION MEMORANDUM
10-02
REVISED

→ Assumes Full Blending for RAP/RAS Binder contribution but does not Δ PG Grade until ≥25% Binder Replacement

TO: District Deputy Commissioners
Technical Services Directors
District Construction Directors
District Testing Engineers
District Area Engineers
Project Engineers/Supervisors
Office of Materials Management

FROM: Mark A. Miller, Director
Division of Construction Management

SUBJECT: RAP Binder Replacement Cost Savings Change Orders

This memo has been revised to clarify the following issues:

1. **The tabulated unit price reductions in this memo are to be considered minimum values. Contractors may submit proposals that include larger proposed unit price reductions if necessary to achieve the minimum $1,000.00 contract credit.**
2. **Pay items that include more than one mixture may also incorporate the proposed specification change if the contract credit requirements are met. An example of how to determine the appropriate unit price adjustment for these pay items has been added to the memo.**

Recently the Standards Committee approved changes to the specifications regarding RAP used in QC/QA HMA and HMA mixtures. The new specification introduces the concept of binder replacement instead of establishing a maximum allowable percentage of RAP in a mixture based on weight.

The new specification allows up to 40% of the total binder in a mix design to be provided by the RAP included in the mixture. As a result, a mix design utilizing a high binder content RAP will be able to utilize less RAP than a mix design that includes a RAP with a lesser binder content. It takes more of the lower content RAP to achieve the same binder replacement.

Because of the potential for increased utilization of RAP and decreased levels of virgin binder required in some mix designs, it is anticipated that implementation of the new specification will present

Went to FHWA ETG.

opportunities for cost savings in the future. In an effort to realize cost savings prior to the new specification becoming effective, the Department has determined that Contractors may utilize mix designs that meet the new specification requirements immediately if the Contractor agrees to provide a credit to the Department of **$1,000.00** or greater on an individual contract. This applies to all active contracts.

In order to utilize a mix design that meets the new specification requirement, the Contractor must notify the PE/S and District Testing in writing that it would like to utilize a mix design or designs that meets the new specification requirement. The notice shall also identify all affected pay items, indicate the remaining quantity for each pay item, propose the credit per ton or Mg for each pay item, calculate the total credit associated with each pay item, and calculate the total credit for the contract.

In order to eliminate the need to negotiate revised unit prices on individual contracts, the Department and industry representatives have agreed upon **minimum unit price adjustments** for individual pay items should be adjusted based on the binder replacement level identified on the DMF. These agreed upon **minimum** adjustments are tabulated below:

QC/QA HMA Surface Mixture Credits ($/Ton or Mg)

	Specified Binder Replacement							
	9.5 mm							
Category	**5%**	**10%**	**15%**	**20%**	**25%**	**30%**	**35%**	**40%**
1-2	$0.25	$0.50	$0.76	$1.01	$1.26	$1.55	$1.84	$2.13
3-5	No Specification Change Permitted							
	12.5 mm							
1-2	$0.10	$0.20	$0.31	$0.41	$0.51	$0.75	$0.99	$1.23
3-5	No Specification Change Permitted							

QC/QA HMA, SMA Surface Mixture Credits ($/Ton or Mg)

	Specified Binder Replacement							
	9.5 mm							
Category	**5%**	**10%**	**15%**	**20%**	**25%**	**30%**	**35%**	**40%**
1-2	$0.11	$0.22	$0.33	$0.44	$0.55	$0.83	$1.11	$1.39
3-5	No Specification Change Permitted							
	12.5 mm							
1-2	$0.02	$0.04	$0.06	$0.08	$0.10	$0.35	$0.60	$0.85
3-5	No Specification Change Permitted							

QC/QA HMA Dense Graded Base and Intermediate Mixture Credits ($/Ton or Mg)

	Specified Binder Replacement							
	12.5 mm							
Category	**5%**	**10%**	**15%**	**20%**	**25%**	**30%**	**35%**	**40%**
1-5	$0.10	$0.20	$0.31	$0.41	$0.51	$0.75	$0.99	$1.23
	19.0 mm							
1-5	$0.15	$0.31	$0.46	$0.62	$0.77	$0.99	$1.21	$1.43
	25.0 mm							
1-5	$0.11	$0.22	$0.33	$0.44	$0.55	$0.75	$0.96	$1.16

QC/QA HMA Open Graded Mixture Credits ($/Ton or Mg)

	Specified Binder Replacement							
Category	**5%**	**10%**	**15%**	**20%**	**25%**	**30%**	**35%**	**40%**
	19.0 mm							
1-5	$0.12	$0.24	$0.36	$0.48	$0.60	No Spec. Change Permitted		
	25.0 mm							
1-5	$0.10	$0.20	$0.30	$0.40	$0.50	No Spec. Change Permitted		

HMA Surface Mixture Credits ($/Ton or Mg)

	Specified Binder Replacement							
	9.5 mm							
Category	**5%**	**10%**	**15%**	**20%**	**25%**	**30%**	**35%**	**40%**
A-B	$0.25	$0.50	$0.76	$1.01	$1.26	$1.55	$1.84	$2.13
C-D	No Specification Change Permitted							
	12.5 mm							
A-B	$0.10	$0.20	$0.31	$0.41	$0.51	$0.75	$0.99	$1.23
C-D	No Specification Change Permitted							

HMA Dense Graded Base and Intermediate Mixture Credits ($/Ton or Mg)

	Specified Binder Replacement							
	12.5 mm							
Category	**5%**	**10%**	**15%**	**20%**	**25%**	**30%**	**35%**	**40%**
A-D	$0.10	$0.20	$0.31	$0.41	$0.51	$0.75	$0.99	$1.23
	19.0 mm							
A-D	$0.15	$0.31	$0.46	$0.62	$0.77	$0.99	$1.21	$1.43
	25.0 mm							
A-D	$0.11	$0.22	$0.33	$0.44	$0.55	$0.75	$0.96	$1.16

If a mix design specifies a binder replacement percentage other than those tabulated above, the appropriate **minimum unit price adjustment** can be determined by interpolating between the tabulated values immediately less than and greater than the specified percentage.

If a Contractor proposes to utilize the attached special provision for a pay item that utilizes more than one mixture, the appropriate unit price adjustment is calculated as follows.

Assuming a pay item consists of 60% HMA Base Type B 25.0 mm mixture and 40% HMA Intermediate Type B 19.0 mm mixture and that the Contractor proposed to utilize 25% binder replacement in each mixture.

1. **The tabulated minimum unit price reductions are $0.55/ton for the Base 25.0 mm mixture and $0.77/ton for Intermediate 19.0 mm mixture.**
2. **A 60/40 interpolation between the $0.55/ton (Base 25.0 mm mixture minimum adjustment) and the $0.77/ton (Intermediate 19.0 mm minimum adjustment) results in a minimum unit price reduction for the pay item of $0.64/ton.**

3. **If the minimum unit price reduction does not achieve the minimum $1,000.00 credit to the contract, then the proposed unit price reduction must be increased as necessary to achieve the required minimum credit to the contract.**

Upon receiving this notice, District Testing personnel will review the mix design for conformance to the new specification requirements. If the mix design is found to meet the requirements, District Testing will grant approval subject to execution of the change order required to incorporate the new specifications into the contract and to provide the Department with the associated credit.

The PE/S will verify the credits to the unit prices and the overall contract proposed by the Contractor. If the verified credit to the contract is greater than or equal to **$1,000.00**, the PE/S will prepare the necessary change order document. The attached special provision should be scanned into SiteManager as an attachment to the change order. All existing contract pay items affected by mix designs meeting the new specifications should have their remaining quantities deleted from the contract for each PCN and replaced with an identical quantity of a new pay item which uses the original pay item name with a supplemental description of "2010 HMA Cost Savings".

If there are any questions regarding this memo, please contact the Division of Construction Management Field Engineer assigned to your District.

Attachment—RAP Binder Replacement Special Provision

MAM:jgj

RAP BINDER REPLACEMENT

SECTION 401, BEGIN LINE 118, DELETE AND INSERT AS FOLLOWS:

401.06 Recycled Materials

~~Recycled materials may consist of reclaimed asphalt pavement, RAP, or asphalt roofing shingles, ARS, or a blend of both. RAP shall be the product resulting from the cold milling or crushing of an existing HMA pavement. The RAP shall be processed so that 100% will pass the 2 in. (50 mm) sieve when entering the HMA plant. ARS shall consist of waste from a shingle manufacturing facility No tear-off materials from roofs will be allowed. ARS shall be stockpiled separately from other materials. The coarse aggregate in the recycled materials shall pass the maximum size sieve for the mixture being produced.~~

~~Recycled materials may be used as a substitute for a portion of the new materials required to produce HMA mixtures. When only RAP is used in the mixture, the RAP shall not exceed 25.0% by weight (mass) of the total mixture. When only ARS is used in the mixture, the ARS shall not exceed 5.0% by weight (mass) of the total mixture. For substitution or use, 1.0% of ARS is considered equal to 5.0% RAP. The percentages of recycled materials shall be as specified on the DMF.~~

~~A maximum of 15.0% RAP or 3.0% ARS by weight (mass) of the total mixture may be used in ESAL category 3, 4, or 5 surface mixtures and open graded mixtures. The recycled material for the ESAL category 3, 4, or 5 surface mixtures shall be 100% passing the 3/8 in. (9.5 mm) sieve and 95 to 100% passing the No. 4 (4.75 mm) sieve.~~

~~The combined aggregate properties of a mixture with recycled materials shall be determined in accordance with ITM 584 and shall be in accordance with 904. Gradations of the combined aggregates shall be in accordance with 401.05.~~

~~Mixtures containing 15.0% or less RAP shall use the same grade of binder as specified. The binder for mixtures containing greater than 15.0% and up to 25.0% RAP shall be reduced by one temperature classification, 6°C, for both the upper and lower temperature classifications.~~

Recycled materials may consist of reclaimed asphalt pavement, RAP, or reclaimed asphalt shingles, RAS, or a blend of both. RAP shall be the product resulting from the cold milling or crushing of an existing HMA pavement. The RAP shall be processed so that 100% will pass the 2 in. (50 mm) sieve when entering the HMA plant. The RAP coarse aggregate shall pass the maximum size sieve for the mixture being produced and the RAS shall be 100% passing the 1/2 in. (12.5 mm) sieve. RAP for the ESAL category 3, 4 and 5 surface mixtures shall be 100% passing the 3/8 in. (9.5 mm) sieve and 95 to 100% passing the No. 4 (4.75 mm) sieve.

Recycled materials may be used as a substitute for a portion of the new materials required to produce HMA mixtures. The amount of total binder replaced by binder in the recycled material shall be computed as follows:

$$Binder\ Replacement, \% = \frac{(A \times B) + (C \times D)}{E} \times 100\%$$

where:

A = RAP, % Binder Content
B = RAP, % in Mixture
C = RAS, % Binder Content
D = RAS, % in Mixture
E = Total, % Binder Content in Mixture

RAS may be obtained from either pre-consumer or post-consumer asphalt shingles. Post-consumer asphalt shingles shall be in accordance with AASHTO MP 15 and prepared by a processing company with an IDEM Legitimate Use Approval letter. A copy of this letter shall be submitted to the Engineer. Deleterious material present in post-consumer asphalt shingles shall be limited to the percentages stated in AASHTO MP 15. Pre-consumer and post-consumer asphalt shingles shall not be blended for use in HMA mixtures and shall be stockpiled separately from other materials.

The recycled material percentages shall be as specified on the DMF. HMA mixtures utilizing recycled materials shall be limited to the binder replacement percentages in the following table:

HMA mixtures utilizing RAP or RAS or a blend of RAP and RAS

Maximum Binder Replacement, %								
Mixture Category	Base and Intermediate					Surface		
	Dense Graded			Open Graded		Dense Graded		
	25.0 mm	19.0 mm	12.5 mm	25.0 mm	19.0 mm	12.5 mm	9.5 mm	4.75 mm
1	40.0*			25.0		40.0*		
2	40.0*			25.0		40.0*		
3	40.0*			25.0		15.0		
4	40.0*			25.0		15.0		
5	40.0*			25.0		15.0		

** RAS materials shall not contribute more than 25 % by weight (mass) of the total binder content for any HMA mixture.*

The combined aggregate properties shall be in accordance with 904. The combined aggregate bulk specific gravity shall be determined in accordance with ITM 584 and the combined aggregate gradation shall be in accordance with 401.05 for the HMA mixture specified.

HMA mixtures with a binder replacement less than or equal to 25.0% by weight (mass) of the total binder content by utilizing RAP or RAS or a blend of RAP and RAS materials shall use the specified binder grade.

HMA mixtures with a binder replacement greater than 25.0% and less than or equal to 40.0% by weight (mass) of the total binder content by utilizing RAP or a blend of RAP and RAS shall use a binder grade with upper and lower temperature classifications reduced by 6°C from the specified binder grade. RAS materials shall not contribute more than 25.0% by weight (mass) of the total binder content for any HMA mixture.

SECTION 402, BEGIN LINE 18, DELETE AS FOLLOWS:

402.03 Materials

Materials shall be in accordance with the following:

Asphalt Materials
PG Binder~~, PG 58-28*, PG 64-22, PG 64-28*, PG 70-22, PG 76-22~~ .....902.01(a)
Coarse Aggregates 904
Base Mixtures, – Class D or Higher
Intermediate Mixtures – Class C or Higher
~~*~~* Surface Mixtures – Class B or Higher*
Fine Aggregates 904
~~* Only for use in mixtures containing greater than 15% RAP. Refer to 402.05.~~
~~*~~* Surface aggregate requirements are listed in 904.03(d).

SECTION 402, BEGIN LINE 39, INSERT AS FOLLOWS:

Mixture Type	Type A	Type B	Type C	Type D
Design ESAL	200,000	2,000,000	9,000,000	11,000,000
Surface	*4.75 mm*	*4.75 mm*	*4.75 mm*	*4.75 mm*
	9.5 mm	9.5 mm	9.5 mm	9.5 mm
	12.5 mm	12.5 mm	12.5 mm	12.5 mm
Surface – PG Binder	64-22	64-22	70-22	70-22
Intermediate	12.5 mm	12.5 mm	12.5 mm	12.5 mm
	19.0 mm	19.0 mm	19.0 mm	19.0 mm
Intermediate – PG Binder	64-22	64-22	64-22	70-22
Base	19.0 mm	19.0 mm	19.0 mm	19.0 mm
	25.0 mm	25.0 mm	25.0 mm	25.0 mm
Base – PG Binder	64-22	64-22	64-22	64-22

HMA may be produced as warm-mix asphalt, WMA by using a water-injection foaming device for temporary HMA mixtures and type A, B and C mixtures. The DMF shall list the minimum plant discharge temperature for HMA and WMA as applicable to the mixture.

SECTION 402, BEGIN LINE 87, DELETE AND INSERT AS FOLLOWS:

(c) Composition Limits for Temporary HMA Mixtures

Temporary HMA mixtures shall be *the* type ~~B~~ *specified* in accordance with 402.04. A MAF in accordance with 402.05 will not apply.

SECTION 402, BEGIN LINE 102, DELETE AND INSERT AS FOLLOWS:

402.08 Recycled Materials

~~Recycled materials may consist of reclaimed asphalt pavement, RAP, or asphalt roofing shingles, ARS, or a blend of both. RAP shall be the product resulting from the cold milling or crushing of an existing HMA pavement. The RAP shall be processed so that 100% will pass the 2 in. (50 mm) sieve when entering the HMA plant. ARS shall consist of waste from a shingle manufacturing facility. No tear-off materials from roofs will be allowed. ARS shall be stockpiled separately from other materials. The coarse aggregate in the recycled materials shall pass the maximum size sieve for the mixture being produced.~~

~~Recycled materials may be used as a substitute for a portion of the new materials required to produce HMA mixtures. When only RAP is used in the mixture, the RAP shall not exceed 25.0% by weight~~

~~(mass) of the total mixture. When only ARS is used in the mixture, the ARS shall not exceed 5.0% by weight (mass) of the total mixture. For substitution or use, 1.0% of ARS is considered equal to 5.0% RAP. The percentages of recycled materials shall be as specified on the JMF.~~

~~A maximum of 15.0% RAP or 3.0% ARS by weight (mass) of the total mixture may be used in type C and D surface mixtures provided the recycled material is 100% passing the 3/8 in. (9.5 mm) sieve and 95% to 100% passing the No. 4 (4.75 mm) sieve.~~

~~The combined aggregate properties of a mixture with recycled materials shall be determined in accordance with ITM 584 and shall be in accordance with 904. Gradations of the combined aggregates shall be in accordance with 402.03.~~

~~Mixtures containing 15.0% or less RAP shall use the same grade of binder as specified. The binder for mixtures containing greater than 15.0% and up to 25.0% RAP shall be reduced by one temperature classification, 6°C, for both the upper and lower temperature classifications.~~

Recycled materials may consist of reclaimed asphalt pavement, RAP, or reclaimed asphalt shingles, RAS or a blend of both. RAP shall be the product resulting from the cold milling or crushing of an existing HMA pavement. The RAP shall be processed so that 100% will pass the 2 in. (50 mm) sieve when entering the HMA plant. The RAP coarse aggregate shall pass the maximum size sieve for the mixture being produced and the RAS shall be 100% passing the 1/2 in. (12.5 mm) sieve. RAP for the type C and D surface mixtures shall be 100% passing the 3/8 in. (9.5 mm) sieve and 95 to 100% passing the No. 4 (4.75 mm) sieve.

Recycled materials may be used as a substitute for a portion of the new materials required to produce HMA mixtures. The amount of total binder replaced by binder in the recycled material shall be computed as follows:

$$\text{Binder Replacement},\% = \frac{(A \times B) + (C \times D)}{E} \times 100\%$$

where:

A = RAP, % Binder Content
B = RAP, % in Mixture
C = RAS, % Binder Content
D = RAS, % in Mixture
E = Total, % Binder Content in Mixture

RAS may be obtained from either pre-consumer or post-consumer asphalt shingles. Post-consumer asphalt shingles shall be in accordance with AASHTO MP 15 and prepared by a processing company with an IDEM Legitimate Use Approval letter. A copy of this letter shall be submitted to the Engineer. Deleterious material present in post-consumer asphalt shingles shall be limited to the percentages stated in AASHTO MP 15. Pre-consumer and post-consumer asphalt shingles shall not be blended for use in HMA mixtures and shall be stockpiled separately from other materials.

The recycled material percentages shall be as specified on the DMF. HMA mixtures utilizing recycled materials shall be limited to the binder replacement percentages in the following table:

HMA mixtures utilizing RAP or RAS or a blend of RAP and RAS

Maximum Binder Replacement, %						
Mixture Category	*Base and Intermediate*			*Surface*		
	Dense Graded			*Dense Graded*		
	25.0 mm	*19.0 mm*	*12.5 mm*	*12.5 mm*	*9.5 mm*	*4.75 mm*
A	*40.0**			*40.0**		
B	*40.0**			*40.0**		
C	*40.0**			*15.0*		
D	*40.0**			*15.0*		

** RAS materials shall not contribute more than 25 % by weight (mass) of the total binder content for any HMA mixture.*

The combined aggregate properties shall be in accordance with 904. The combined aggregate bulk specific gravity shall be determined in accordance with ITM 584 and the combined aggregate gradation shall be in accordance with 401.05 for the HMA mixture specified.

HMA mixtures with a binder replacement less than or equal to 25.0% by weight (mass) of the total binder content by utilizing RAP or RAS or a blend of RAP and RAS materials shall use the specified binder grade.

HMA mixtures with a binder replacement greater than 25.0% and less than or equal to 40.0% by weight (mass) of the total binder content by utilizing RAP or a blend of RAP and RAS shall use a binder grade with upper and lower temperature classifications reduced by 6°C from the specified binder grade. RAS materials shall not contribute more than 25.0% by weight (mass) of the total binder content for any HMA mixture.

SECTION 402, BEGIN LINE 392, INSERT AS FOLLOWS:

HMA for Temporary Pavement, *Type* __*__ ..... TON (Mg)

SECTION 410, BEGIN LINE 93, DELETE AND INSERT AS FOLLOWS:

410.06 Recycled Materials

~~Recycled materials may consist of reclaimed asphalt pavement, RAP, or asphalt roofing shingles, ARS, or a blend of both. RAP shall be the product resulting from the cold milling or crushing of an existing HMA pavement. The recycled material shall be 100% passing the 3/8 in. (9.5 mm) sieve and 95% to 100% passing the No. 4 (4.75 mm) sieve when entering the HMA plant. ARS shall consist of waste from a shingle manufacturing facility. No tear-off materials from roofs will be allowed. ARS shall be stockpiled separately from other materials.~~

~~Recycled materials may be used as a substitute for a portion of the new materials required to produce mainline surface. When only RAP is used in the mixture, the RAP shall not exceed 15.0% by weight (mass) of the total mixture. When only ARS is used in the mixture, the ARS shall not *exceed* 3.0% by weight (mass) of the total mixture. For substitution or use, 1.0% of ARS is considered equal to 5.0% RAP. The percentages of recycled materials shall be as specified on the DMF.~~

~~The combined aggregate properties of a mixture with recycled materials shall be determined in accordance with ITM 584 and shall be in accordance with 904. Gradations of the combined aggregates shall be in accordance with 410.05.~~

~~Mixtures containing RAP shall use the same grade of binder as specified~~.

Recycled materials may consist of reclaimed asphalt pavement, RAP, or reclaimed asphalt shingles, RAS or a blend of both. RAP shall be the product resulting from the cold milling or crushing of an existing HMA pavement. The RAP shall be processed so that 100% will pass the 2 in. (50 mm) sieve when entering the HMA plant. ~~*The RAP coarse aggregate shall pass the maximum size sieve for the mixture being produced and the*~~ *RAS shall be 100% passing the 1/2 in. (12.5 mm) sieve. RAP* ~~*for the ESAL category 3, 4 and 5 surface mixtures*~~ *shall be 100% passing the 3/8 in. (9.5 mm) sieve and 95 to 100% passing the No. 4 (4.75 mm) sieve.*

Recycled materials may be used as a substitute for a portion of the new materials required to produce SMA mixtures. The amount of total binder replaced by binder in the recycled material shall be computed as follows:

$$\text{Binder Replacement},\% = \frac{(A \times B) + (C \times D)}{E} \times 100\%$$

where:

A = RAP, % Binder Content
B = RAP, % in Mixture
C = RAS, % Binder Content
D = RAS, % in Mixture
E = Total, % Binder Content in Mixture

RAS may be obtained from either pre-consumer or post-consumer asphalt shingles. Post-consumer asphalt shingles shall be in accordance with AASHTO MP 15 and prepared by a processing company with an IDEM Legitimate Use Approval letter. A copy of this letter shall be submitted to the Engineer. Deleterious material present in post-consumer asphalt shingles shall be limited to the percentages stated in AASHTO MP 15. Pre-consumer and post-consumer asphalt shingles shall not be blended for use in SMA mixtures and shall be stockpiled separately from other materials.

The recycled material percentages shall be as specified on the DMF. SMA mixtures utilizing recycled materials shall be limited to the binder replacement percentages in the following table:

SMA mixtures utilizing RAP or RAS or a blend of RAP and RAS

Maximum Binder Replacement, %		
SMA Surface		
Mixture Category	12.5 mm	9.5 mm
1	40.0*	40.0*
2	40.0*	40.0*
3	15.0	15.0
4	15.0	15.0
5	15.0	15.0

** RAS materials shall not contribute more than 25 % by weight (mass) of the total binder content for any HMA mixture.*

The combined aggregate properties shall be in accordance with 904. The combined aggregate bulk specific gravity shall be determined in accordance with ITM 584 and the combined aggregate gradation shall be in accordance with 401.05 for the SMA mixture specified.

SMA mixtures with a binder replacement less than or equal to 25.0% by weight (mass) of the total binder content by utilizing RAP or RAS or a blend of RAP and RAS materials shall use the specified binder grade.

SMA mixtures with a binder replacement greater than 25.0% and less than or equal to 40.0% by weight (mass) of the total binder content by utilizing RAP or a blend of RAP and RAS shall use a binder grade with upper and lower temperature classifications reduced by 6° C from the specified binder grade. RAS materials shall not contribute more than 25.0% by weight (mass) of the total binder content for any SMA mixture.